The Dow Chemical Company
Midland, MI 48674

October 15, 2007

George Bruchmann, Chief
Waste and Hazardous Materials Division
State of Michigan Department of Environmental Quality
Constitution Hall
525 West Allegan Street
Lansing, MI 48909-7741

RE: Revised Saginaw River / Bay Remedial Investigation Scope of Work

Enclosed please find The Dow Chemical Company's revised Scope of Work (SOW) for conducting a Remedial Investigation of the Saginaw River and Saginaw Bay. The original SOW was submitted to the Michigan Department of Environmental Quality (MDEQ) on July 12, 2007. The SOW has been revised, where appropriate, in response to MDEQ's Notice of Deficiency issued on August 31, 2003.

Approval of this SOW by MDEQ is required as part of Condition XI.B of the Midland-Operations Hazardous Waste Management Facility Operating License (License) issued by the Michigan Department of Environmental Quality (MDEQ) on June 12, 2003.

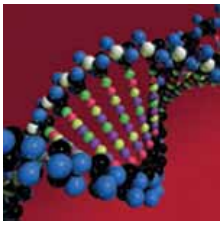
We look forward to working with you and your staff. Please contact me at (989) 636-0787 to discuss next steps in this process.

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Sincerely,

Ben Baker
Sr. Environmental Project Leader
Sustainable Development
1790 Building
Midland, MI 48674

Enclosure(s)


REMEDIAL INVESTIGATION SCOPE OF WORK
FOR THE
SAGINAW RIVER AND SAGINAW BAY, MICHIGAN

Prepared for

THE DOW CHEMICAL COMPANY

Prepared by

ENVIRON

15 October 2007

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EXECUTIVE SUMMARY

This *Saginaw River / Bay Remedial Investigation (RI) - Scope of Work (SOW)* has been prepared by The Dow Chemical Company (Dow) in accordance with the requirements of Dow's Hazardous Waste Operating License (License) for addressing corrective actions beyond the boundary of the Michigan Operations-Midland Plant located in Midland, Michigan. This SOW addresses the work to be performed in Saginaw River and Saginaw Bay (Saginaw River / Bay) sediments and floodplain.

The intent of this work is to address the Saginaw River / Bay in a single, comprehensive investigation framework, thereby distinguishing investigation activities conducted in the Saginaw River and in Saginaw Bay from those conducted in the Tittabawassee River. The SOW, once approved by the Michigan Department of Environmental Quality (MDEQ), will be the basis for the submittal of an RI Work Plan (RIWP) for the Saginaw River / Bay within sixty (60) days thereafter.

The work embodied in this SOW has four objectives: (1) supplement the current understanding of chemical and physical characterization data in Saginaw River / Bay sediments and floodplain soils (river / bay characterization); (2) support other activities that contribute to the evaluation and identification of appropriate final remedies with respect to dioxins (herein referring to a group of chemicals known as polychlorinated dibenzo-p-dioxins, i.e., PCDDs, and including polychlorinated dibenzofurans, i.e., PCDFs) and potential chemicals of interest (PCOIs) associated with releases from the Dow Midland Plant (human / ecological risk); (3) evaluate the need for and/or implement interim actions and develop data that contributes to a Saginaw River / Bay remedy alternatives analysis and remedy decision-making (remedy / corrective action); and, (4) support the development or refinement of a sediment management decision for Saginaw River / Bay, particularly with regard to final resolution of sediment-related issues for both the Tittabawassee River and Saginaw River / Bay (long-term sediment decision).

Overall, the scope of work to be conducted will include the following types of investigation activities in the Saginaw River / Bay:

- Topographic, bathymetric, and geophysical surveys to understand the physical characteristics;
- Hydrologic monitoring and modeling to understand water flow at different times of year;
- River morphological surveys to understand how land use along the river and bay has changed over time;
- Sampling of sediments and floodplain soils and testing for dioxins and PCOIs;
- Sampling of certain beaches in Saginaw Bay and testing for dioxins;
- Ecological studies to evaluate impacts to fish and indigenous wildlife; and,
- Assessment of the potential for human exposure to evaluate the possible impact on human health.

This work will be conducted on the basis of existing information, as well as data developed from pre-RI investigation work conducted on the river and bay to address data gaps and supplement information compiled as part of the draft *Current Conditions Report for the Saginaw River / Bay*. The draft *Current Conditions Report for the Saginaw River / Bay* was submitted by Dow to MDEQ on September 17, 2007. The *Saginaw River / Bay Pre-RI Investigation Work Plan (IWP)* was submitted by Dow to MDEQ on September 14, 2007.

1. INTRODUCTION

This *Saginaw River / Bay Remedial Investigation (RI) - Scope of Work (SOW)* has been prepared by The Dow Chemical Company (Dow) in accordance with the requirements of Dow's Hazardous Waste Operating License (License) for addressing corrective actions beyond the boundary of the Michigan Operations-Midland Plant located in Midland, Michigan. Condition Part XI, Section B.6 of the License requires Dow to submit a SOW to the Michigan Department of Environmental Quality (MDEQ) for conducting an RI for certain offsite areas. This SOW addresses the work to be performed in Saginaw River and Saginaw Bay (Saginaw River / Bay) sediments and floodplain. The work proposed herein also is consistent with the January 2005 *Framework for an Agreement between the State of Michigan and The Dow Chemical Company* for addressing the Saginaw River / Bay.

1.1 Purpose and Overview

The work will be conducted to meet applicable requirements of the License, Parts 111 and applicable portions of 201 of Act 451, as well as relevant Resource Conservation and Recovery Act (RCRA) regulations. Table 1-1 summarizes how this SOW will address MDEQ requirements for performing the work.

The intent of this work is to address the entire Saginaw River / Bay in a single, comprehensive investigation.

This SOW, once approved by MDEQ, will be the basis for the submittal of an RI Work Plan (RIWP) for the Saginaw River / Bay within sixty (60) days thereafter. The RIWP will be developed to provide the information necessary to support a risk-based decision process and achieve the goal of a remedial investigation as set forth in R 299.5528, "*The purpose of a remedial investigation is to assess site conditions in order to select an appropriate remedial action, if one is required, and that adequately addresses those conditions.*" The RIWP will address the factors described in R 299.5528 (3), "…*as appropriate to the facility*…", as well as support the collection of data useful to natural resource damage assessment (NRDA) work that is being conducted concurrently with investigation activities on the Tittabawassee River and in Saginaw River / Bay.

1.2 Approach

1.2.1 Objectives

The work embodied in this SOW is based on four objectives:

(1) Supplement the current understanding of chemical and physical characterization data in Saginaw River / Bay sediments and floodplain soils (river / bay characterization);

(2) Support other activities that contribute to the evaluation and identification of appropriate final remedies with respect to dioxins (herein referring to a group of chemicals known as polychlorinated dibenzo-p-dioxins, i.e., PCDDs, and including polychlorinated dibenzofurans, i.e, PCDFs) and potential chemicals of interest (PCOIs) associated with releases from the Dow Midland Plant (human / ecological risk);

(3) Evaluate the need for and/or implement interim actions and develop data that contributes to a Saginaw River / Bay remedy alternatives analysis and remedy decision-making (remedy / corrective action); and,

(4) Support the development or refinement of a sediment management decision for Saginaw River / Bay, particularly with regard to final resolution of sediment-related issues for both the Tittabawassee River and Saginaw River / Bay (long-term sediment decision).

With respect to the first three objectives above, work will be performed that is consistent with Michigan and federal guidance and regulations that apply to the remedial investigation / feasibility study (RIFS) process. With respect to the long-term sediment decision objective, work will be consistent with current U.S. EPA sediment management principles [1] and sediment remediation guidance [2], emerging guidance on watershed restoration [3], and Michigan's Part 111 and Part 201, Rule 730 regulations.

The types of questions to be addressed by the work embodied in the SOW fall into each of these four objectives – river / bay characterization; human / ecological risk; remedy / corrective action; and long-term sediment decision – and include, for example, but are not limited to the following:

- *River / bay characterization:* From evaluation of the available existing information and data generated during work….what is the distribution of dioxins and PCOIs associated with releases from the Dow Midland Plant in Saginaw River / Bay?; what are the nature, extent, and environmental fate of dioxins and PCOIs?; are there relationships between geospatial factors (e.g., elevation, geomorphology, river hydrodynamics, land use, etc.,) and the presence or absence in sediments of dioxins and PCOIs?; what is the mass (to the extent reasonably determinable) of dioxins and PCOIs moving into the Saginaw River from the Tittabawassee River and from the Saginaw River into Saginaw Bay?; is the occurrence of PCOIs associated with historical releases from the Dow Midland Plant?

1. U.S. EPA 2002. Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites. See http://www.epa.gov/superfund/resources/remedy/pdf/92-85608-s.pdf
2. U.S. EPA 2005. Contaminated Sediment Remediation Guidance at Hazardous Waste Sites. See http://www.epa.gov/superfund/resources/sediment/guidance.htm
3. See the U.S. EPA program on the Internet at http://www.epa.gov/owow/watershed/

- *Human / ecological risk:* From evaluation of the available existing information and data generated during work….what human health and ecological exposure pathways are present and represent a potentially significant source of exposure to dioxins and PCOIs in and along Saginaw River / Bay?; which dioxins and PCOIs most influence the predicted ecological and/or human health risks?

- *Remedy / corrective action:* From evaluation of the available existing information and data generated during work….what are necessary, appropriate and cost-effective remedial actions to address site-specific human and ecological risks?

- *Long-term sediment decision:* From evaluation of the available existing information and data generated during work….what solutions are needed, if any, to address risks, if any, to residents of local communities and ecological receptors?; what tools will be effective for monitoring environmental conditions in the watershed?; what conditions, if any, are important to monitor and directly relate to affected conditions, if any, in the river, bay, or watershed?

Data quality objectives (DQOs) will be proposed as part of the RIWP and applied throughout the investigation work that clearly identify the questions that will be answered by data generated from the work and ensure that the proper type and quality of data are collected. Consequently, a fifth objective of the SOW addresses data management. Data generated in the course of work conducted as part of the SOW will be documented consistent with available RIFS guidance, subject to independent review where appropriate, and managed in a manner that is transparent to MDEQ and other regulatory agencies and the public. The data will be made available to MDEQ and other regulatory agencies and the public pursuant to the requirements of Dow's License. Data management will be handled consistent with the specifications contained in a Quality Assurance Project Plan (QAPP), which will be included as part of the RIWP prepared after approval of this SOW.

1.2.2 Implementation of the Work

The purpose of this SOW is to provide a general description of the process, steps, and schedule for implementation of investigation work activities in the Saginaw River / Bay. Specific planning and implementation details will be developed and presented in the RIWP. The RIWP will be prepared and submitted to MDEQ within sixty (60) days after approval of this SOW. Performance of the work is based on the following sequence of activities:

a. Preparation and submission of a SOW, and approval of the SOW by MDEQ

Under the terms of Dow's License, a SOW that describes the scope and schedule of work that will be conducted in the Saginaw River / Bay must be submitted to MDEQ by August 12, 2007. The SOW was submitted by Dow to MDEQ on July 13, 2007. An RIWP is due within 60 days after the approval of this SOW by MDEQ.

b. Compilation of available environmental information relevant to understanding current conditions in the river and bay and to identifying data gaps, and submittal of a draft Current Conditions Report for the Saginaw River / Bay to MDEQ, and approval of the document by MDEQ;

In conjunction with preparing the SOW, available existing information describing current environmental conditions in Saginaw River / Bay were compiled and summarized. This information was reported in a draft *Current Conditions Report for the Saginaw River / Bay* submitted to MDEQ on September 17, 2007. The draft *Current Conditions Report for the Saginaw River / Bay* will be used to guide the development of the RIWP and the collection of data needed to (a) fulfill site characterization needs, and/or (b) support the determination of the need for interim remedial actions (IRAs) and decisions regarding final corrective actions (CAs). Based on the existing information and interpretation of current environmental conditions reported in the available studies and technical reports, some aspects of the river and bay are well understood and require little, if any, further investigation and characterization.

c. Implementation of preliminary, pre-RI investigations in Saginaw River / Bay in accordance with the Saginaw River / Bay Pre-RI Investigation Work Plan (IWP) submitted to MDEQ on September 14, 2007 to supplement existing available data compiled as part of the draft Current Conditions Report for the Saginaw River / Bay;

Concurrent with preparation of the RIWP, preliminary, pre-RI, work is being conducted in the river and bay to address data gaps and supplement information compiled as part of the draft *Current Conditions Report for the Saginaw River / Bay*. The data developed from this work will form the basis for future investigation and data evaluation, as well as provide data that can be used for screening level analyses of certain areas of the river and bay. Work is being conducted during the fall 2007 and data collection will be completed by mid-November, when winter conditions are likely to impede the ability to perform field work safely. The work is supported by a *Saginaw River / Bay Investigation Work Plan (IWP)*. The work described in the IWP and initiated in September 2007 includes the following:

- Topographic, bathymetric, and geophysical surveys,
- Installation of water level and flow meters (hydrologic monitoring),
- River morphological studies,
- Geospatial analysis of available data to support focused river / bay sediment sampling,
- Sampling of sediments and floodplain soils along the Saginaw River,
- Sampling of sediments from certain beaches along Saginaw Bay, and
- Sampling of water at a municipal drinking water plant that draws water from the bay.

d. Preparation and submittal of an RIWP, after approval of the SOW, for approval by MDEQ

Following submission of the SOW and approval by MDEQ, a detailed RIWP will be prepared and submitted to MDEQ for approval that describes the work to be initiated beginning in 2008. The RIWP will be developed based on the information compiled as part of the draft *Current Conditions Report for the Saginaw River / Bay* and the evaluation of existing information and data generated from the

preliminary, pre-RI work conducted during the fall 2007. The work described in the RIWP will be conducted in three phases:

Phase 1 – This work includes preliminary hydrologic modeling and initial screening risk assessment studies supported by the information contained in the draft *Current Conditions Report for the Saginaw River / Bay* and data generated as part of preliminary, pre-RI, work. The results of Phase 1 will be used to support definition of the scope of Phase 2 work.

Phase 2 – This work includes field investigation activities. The purpose of field work is to collect data to improve the understanding of sediment physical stability, chemical stability, and human use and ecological/biological community conditions. The results of Phase 1 and Phase 2 work will be used to support definition of the scope of Phase 3 work.

Phase 3 – This work includes additional hydrologic modeling initiated during Phase 1 and detailed risk assessment studies, if needed, as well as implementation of additional field investigation work, if needed, to achieve the objectives described in this SOW and complete the work specified in the RIWP.

The RIWP may be supplemented by additional work plans addressing Phase 2 and Phase 3 activities, as more information is gathered and evaluated during the course of investigations. Supplemental work plans would provide more specific information regarding sample locations, numbers of samples, sample matrices, analyses and methods, sampling frequency and duration, survey methods, project schedule, health and safety, data quality objectives, and quality assurance requirements. The standard operating procedures, investigation and testing methods, and other project support activities will reflect, to the extent practical, the approaches adopted for the Tittabawassee River investigation.

e. Implementation of field sampling and survey activities specified in the RIWP

Field investigation activities described in the RIWP will focus on the Saginaw River (beginning at the confluence with the Tittabawassee and Shiawassee Rivers and extending to Saginaw Bay) and inner Saginaw Bay (see Figure 1-1). Saginaw River studies will target hydrodynamic conditions, river bottom and river bank sediments, sediment transport within the river, floodplain areas immediately adjacent to the river, as appropriate, biological and ecological conditions, surface water conditions, and potential for human and ecological exposure to dioxins and PCOIs. Saginaw Bay studies will focus on hydrodynamics, sediment transport within the bay, bay sediments and beachfronts proximate to the mouth of the Saginaw River, biological and ecological conditions, and potential for human and ecological exposure to dioxins and PCOIs.

f. Preparation of work summary reports and the overall final Saginaw River / Bay RIWP report and submittal to MDEQ

Summary reports describing the status of work activities, data, and interpretation of findings will be prepared periodically during the course of work. Reports will include quarterly summaries of data, supplemental Phase 2, and 3 work plans (as needed), and Phase 1, 2, and 3 summary reports of findings. An overall final Saginaw River / Bay RIWP report will be prepared and submitted to MDEQ at the conclusion of the work.

2. SCOPE OF WORK

The primary purpose of the work summarized in this SOW is to characterize the fate and transport of substances originating from the Dow Midland Plant and transported via the Tittabawassee River through the Saginaw River and into Saginaw Bay, as well as any associated risks to human health and the environment.

As indicated in Section 1, the work embodied in this SOW addresses four objectives: (1) supplement the current understanding of chemical and physical characterization data in river and bay sediments and floodplain soils (river characterization), (2) support other activities that will contribute to the evaluation and identification of appropriate final remedies with respect to dioxins and PCOIs associated with releases from the Dow Midland Plant; (3) evaluate the need for and/or implement interim actions and develop data that support future remedy alternatives analysis and remedy decision-making, and (4) support the development or refinement of a sediment management decision for Saginaw River / Bay, particularly with regard to the final resolution of sediment-related issues for both the Tittabawassee River and Saginaw River / Bay.

2.1 Definition of Study Area

The study area includes the Saginaw River and Saginaw Bay. In the Saginaw River, the study area begins at the eastern point of Green Point Island, at the confluence of the Tittabawassee River and the Shiawassee River just south of Saginaw, Michigan. From the confluence, the Saginaw River flows north for 22.3 miles through Saginaw County and Bay County, and through the cities of Saginaw, Zilwaukee, Bay City, and Essexville and ends at the confluence with Saginaw Bay. In Saginaw Bay, at this point in time and subject to data to be obtained, the study area begins at the confluence with the Saginaw River and extends six miles in to the bay and 4 miles laterally from each side of the current navigational channel, as well as beaches along the shore of the bay within this area.

The Saginaw River is divided into the three primary reaches for the purpose of communicating investigation data and findings. The Upper Saginaw River (USR) extends from the confluence with the Tittabawassee River to (but not including) the Sixth Street Turning Basin, a distance of approximately five (5) river miles. The Lower Saginaw River in Saginaw County (LSR-SC) extends from the Sixth Street Turning Basin to the Saginaw County-Bay County boundary, a distance of approximately six (6) river miles. The Lower Saginaw River in Bay County (LSR-BC) extends from the Saginaw County - Bay County boundary to the mouth of the river at Saginaw Bay, a distance of approximately eleven (11) river miles.

Work will focus on (a) sediment in the Saginaw River / Bay, (b) soil in levees and river banks along the Saginaw River where evidence of sediment deposition exists, (c) floodplain soil along the Saginaw River where evidence of flooding and sediment deposition exists, (d) hydrologic behavior of the Saginaw River / Bay; and (e) ecology and aquatic biota in Saginaw River / Bay. Work will take place

within the boundaries of the estimated FEMA 100-year floodplain. This work will involve a tiered approach that does not presume contamination exists in all areas, but rather uses geostatistics, modeling, and other investigation and assessment tools and the progressive collection of data to identify and evaluate conditions in the river and bay.

2.2 Investigation Activities

Following approval of this SOW, an RIWP will be prepared and submitted to MDEQ describing the following work:

Phase 1 Activity

1. Data Analysis Supporting Focused River / Bay Sediment, Soil, and Ecological/Biological Sampling
    - Geostatistical analysis of pre-RI data and previously collected sediment physical and chemical data
    - Evaluation of existing ecological / biological data, including habitat conditions
    - Interpretation of available bathymetric, geophysical and topographic data
    - Evaluation of human use of river / bay resources
    - Identification of PCOIs
2. Preliminary Hydrologic and Sediment Transport Modeling
    - Evaluation of available hydrologic models and data pertaining to the river or bay
    - Review of historical and current information delineating the floodplain
    - Evaluation of available sediment transport models and data pertaining to the river or bay
    - Development of 2-D surface water flow models to support hydrodynamic and sediment transport analysis
3. Screening Human and Ecological Risk Assessments
    - Exposure pathway and receptor analysis
    - Development of exposure models
    - Screening exposure and risk analysis
    - Identification of potential risk drivers in the river and bay
4. Refinement of the initial pre-RI River/Bay Conceptual Site Model (CSM)
5. Refinement or Preparation of Supplemental (if needed) RIWP Phase 2 Work Plan
6. Preparation and Submission of Data Summaries and Preliminary Findings

Phase 2 Activity

1. Topographic, Bathymetric, and Geophysical Surveys (if needed)
2. Continuation of Hydrologic and Sediment Transport Modeling and Supporting Work
    - Development of data to support hydrologic modeling
    - Development of data related to sediment bedload and suspended sediment load
    - Monitoring during wet-weather and dry-weather periods with both boat mounted equipment and long-term in-river equipment deployments

- Evaluation of the effects of marine transportation traffic and dredging in river and bay navigation channels

3. River Morphological Studies (if needed)
   - Collection of river sinuosity measurements
   - Characterization of sediment deposits, levees, scour areas, plants, and their structures
4. River / Bay Sediment and Floodplain Soil Sampling
   - Collection of sediment and floodplain soil to characterize physical and non-chemical conditions
   - Collection of sediment and floodplain soil to characterize dioxins and PCOIs
5. Studies Supporting Detailed Ecological and Human Health Risk Assessments
   - Collection of additional environmental data to address data gaps and reduce uncertainties identified in Phase 1 screening assessments
   - Collection of additional ecological data to address data gaps and reduce uncertainties identified in the Phase 1 screening assessment
6. Refinement of the River / Bay Conceptual Site Model (CSM)
7. Refinement or Preparation of Supplemental (if needed) RIWP Phase 3 Work Plan
8. Preparation and Submission of Data Summaries and Preliminary Findings

Phase 3 Activity

1. Completion of Hydrologic and Sediment Transport Modeling and Supporting Studies
   - Evaluation of river and bay sediments, river banks, and floodplain soil stability
   - Evaluation of sediment fate and transport in the river and bay
2. Completion of Floodplain Soils Characterization
   - Additional sampling to address data gaps in physical and/or chemical characterization
3. Completion of River / Bay Sediment Characterization
   - Additional sampling to address data gaps in physical and/or chemical characterization
4. Completion of River / Bay Ecological / Biological Characterization
   - Additional sampling to address data gaps relevant to understanding ecology and biota
5. Detailed Ecological and Human Health Risk Assessments
   - Determination of site-specific exposure limits to dioxins and PCOIs
   - Probabilistic analysis of exposure and risk to evaluate uncertainty
   - Evaluation of different potential use impairments identified under Michigan Rule 730
6. Interim Action and Pre-Remedy Evaluation
   - Evaluation of the need for interim actions to address conditions that pose potential health or ecological risks in the river and bay
   - Preliminary assessment of the range of remedies potentially appropriate for consideration
7. Preparation and Submission of Data Summaries and RIWP Report of Findings

2.3 Data Quality Objectives (DQOs)

The DQOs developed to support Phase 1, 2, and 3 RIWP work will ensure that the proper type and quality of site characterization data will be collected to meet the objectives of the work. The DQOs will be focused on important environment and risk–related questions (such as those identified in Section 1 above) and the following types of data needs:

- Characterization of the physical system
- Potential contaminants of interest
- Nature and extent
- Fate and transport
- Human health risk assessment
- Ecological risk assessment
- Consideration of phased data collection
- Evaluation of interim and final remedial alternatives

2.4 Hydrology

Work will address hydrodynamics and sediment transport using data from existing studies and new information generated from field studies. The hydrologic work also will address impacts posed by navigation traffic and periodic dredging in the river and bay navigation channels. Understanding surface water hydrology contributes to understanding sediment transport processes and river morphology, including sediment deposition, sediment stability, and suspended sediment transport. The fate and transport of hydrophobic contaminants strongly sorbed to sediment particles is linked to the fate and transport of the sediment particles themselves. In net depositional environments, this can lead to the accumulation of sediment contaminants, and burial following source control. In areas where higher flow velocities limit the amount of burial and net sediment deposition, contaminated sediment particles may be transported downstream to relatively quiescent areas.

2.5 Geomorphology and Sediment Characteristics

Work activities will characterize river morphology and sediment characteristics, with particular focus on its influence on contaminant deposition and burial, contaminant transport, and the overall river ecology (e.g., the role of natural levies, bottom river sediment, wetlands, varying shoreline deposits, and other formations relevant to the natural health and ecological status of the river and bay ecosystems).

Understanding the geomorphology of the river system contributes to understanding sediment behavior in the Saginaw River / Bay. In fact, surface water hydrology and river morphology are closely interconnected; understanding one contributes to understanding the other. Erosion and deposition are the primary processes that operate in the river/floodplain system. Erosion may dominate in some areas (particularly along the outer cut banks of meanders), while deposition will dominate elsewhere

(particularly along the inner point bars of meanders). The general locations of these processes are predictable and identifiable using hydrodynamics, and by identifying morphologic features.

2.6 Topography and Bathymetry

Work activities will characterize river and bay bathymetry and regional topography using existing information, new field bathymetric surveys, and new topographic surveys. Regional topography and river and bay bathymetry are essential to understanding and modeling surface water flows, and thus contribute to the understanding of hydrologic behavior and river morphology. River bathymetry aids in developing a better understanding of net current velocities, localized velocities, and the capacity of the river during normal and high flow conditions. Topography influences the flow of water into the river from the watershed and contributes to hydrologic and sediment loads into the river and bay ecosystems. Topography also defines flood areas and flow conditions during flood events.

2.7 Floodplain Soil

Floodplain soils will be evaluated using available bathymetric and topographic information, including existing data from previous sampling and survey activities and hydrologic and other relevant environmental modeling results to better understand the extent to which floodplain soils may be impacted by the river. Characterization of floodplain soils will be conducted only as needed if initial chemical surveys, hydrodynamic modeling, analysis of historic floods, bathymetry and topography, and past chemical characterization indicate additional evaluation is warranted.

2.8 Saginaw River Sediment

The characterization of Saginaw River sediments will begin with an evaluation of available bathymetric and topographic work and review of existing data to better understand areas in the river that may represent stable or transient sediment deposition areas. Two types of sediment data may be collected – static measurements at depth collected from sediment cores, and dynamic measurements of bedload sediments, suspended sediments, and surficial sediments that may be migrating through the river system. Bedload/suspended/surficial sediment sampling at various times of the year for mass balance determinations has been on-going in the Saginaw River since October 2006 as part of the *Saginaw River Sediment Trap Pilot Study* initiated under the guidance of an ADR Technical Work Group. The results of that work will be incorporated into the RIWP and final report of findings.

For both collection of static or dynamic sediment data, the approach to sediment sampling will be tiered, in order to optimize sample locations, expedite sampling, and manage costs and schedule. The tiered approach will be founded on a review of existing sediment chemistry data, hydrologic modeling data, and geostatistical analyses to understand sediment fate and transport of dioxins and PCOIs in river sediments. The hydrologic modeling and geostatistical analysis will identify areas of the river that do not require further characterization based on existing data and areas that require further confirmation sampling and detailed characterization to support a risk assessment. Sampling will target reaches of the

river where data gaps or geostatistical analyses point to the need for data to establish the distribution in sediments of dioxins and PCOIs associated with historical releases from the Dow Midland Plant.

2.9 Saginaw Bay Sediment

The characterization of Saginaw Bay sediments will begin with an evaluation of available bathymetric and topographic work and review of existing data to better understand areas in the bay that may represent stable or transient sediment deposition areas. Similar to the investigation of river sediments, two types of sediment data may be collected – static measurements at depth collected from sediment cores, and dynamic measurements of bedload sediments, suspended sediments, and surficial sediments that may be migrating from the river and in to the bay. The approach to sediment sampling also will be tiered, in order to optimize sample locations, expedite sampling, and manage costs and schedule. The tiered approach will be founded on a review of existing sediment chemistry data, hydrologic modeling data, and geostatistical analyses to understand sediment fate and transport of dioxins and PCOIs in bay sediments. The hydrologic modeling and geostatistical analysis will identify areas of the bay that do not require further characterization based on existing data and areas that require further confirmation sampling and detailed characterization to support a risk assessment. Sampling will target areas where data gaps or geostatistical analyses point to the need for data to establish the distribution in sediments of dioxins and PCOIs associated with historical releases from the Dow Midland Plant.

2.10 Environmental Chemistry

Saginaw River / Bay has been the focus of sampling and investigation for more than 30 years. Since 1997, sediment samples from the Saginaw River / Bay have been collected by the U.S. Army Corps of Engineers (USACE), MDEQ, and contractors working on behalf of Dow (e.g., ATS, CH2MHill and ENVIRON); floodplain soil samples have been collected by MDEQ; surface water chemistry samples have been collected by USACE and ENVIRON, on behalf of Dow; and biota samples have been collected by MDEQ and their contractors. With few exceptions, samples of all media have been collected from all four reaches of the river (the USR, LSR-SC, and LSR-BC) and the bay.

Work will focus primarily on dioxins and PCOIs that are found in the Tittabawassee River and associated with historical releases from the Dow Midland Plant. In heavily industrialized areas, such as the Saginaw River / Bay, contaminant stressors are rarely limited to a single contaminant and may involve non-chemical stressors; therefore, consideration of non-chemical stressors also will be included in the risk assessment work. The evaluation of chemicals and substances not associated with releases from the Dow Midland Plant also will be considered, as needed, to understand whether their presence may result in impacts on human health and the environment. Understanding the range of contaminants present in sediments – and their sources – may contribute to understanding the range of biological effects that may be present in the river and bay.

2.11 Ecology and Biota

The status of ecological conditions and biota in Saginaw River / Bay will be evaluated consistent with U.S. EPA and Michigan guidance for conducting and evaluating data from ecological and biological studies. Work will focus on assessment of aquatic and riverine and bay habitat conditions, including consideration of wetlands and areas considered important to indigenous and migratory species associated with the aquatic environment. Work will begin with the evaluation of existing data and information reported in the *Current Conditions Report for Saginaw River / Bay* and the results of a screening-level ecological risk assessment to determine the need for data collection to better understand ecological impacts, if any, and support a detailed risk assessment. Available biological and ecological inventories of aquatic conditions in the river and bay will be used in conjunction with risk assessment activities to focus the work on evaluation of indicator species fish, birds, and mammals that are representative of the range of ecological impacts potentially associated with dioxins and PCOIs in sediment and floodplain soil and transfers through an ecological food chain.

2.12 Human Health and Ecological Risk Assessment

Risk assessment work will include both human health risk assessment (HHRA) and ecological risk assessment (ERA) using U.S. EPA and Michigan guidance for conducting screening and detailed risk assessments. The screening and detailed HHRA and ERA will include evaluation of dioxins and PCOIs associated with releases from the Dow Midland Plant. The work will provide information needed to evaluate exposure pathways and potential risks associated with the presence of dioxins and PCOIs in sediments, floodplain soils, and biota in the Saginaw River / Bay.

The HHRA and ERA will identify and screen receptors of potential concern in a systematic and detailed manner, identifying receptors that exhibit complete exposure pathways. Potential exposure pathways for both human and ecological receptors will focus on certain dietary exposures related to the Saginaw River / Bay and direct contact with river sediment, wetland soil, and some floodplain soil. Receptors of potential concern will include those populations that consume Saginaw River / Bay fish and/or have direct contact with river and wetland sediment or floodplain soil. Because risk assessment is an inherently iterative process, the listing of PCOIs, receptors, and exposure pathways will continue to be refined during the work. The initial list of PCOIs may include substances identified from data developed as part of the Tittabawassee River RIWP, as well as substances identified from existing data describing inputs from other river confluences and point or non-point sources. Further, the risk assessments will include consideration of non chemical stressors such as historically altered hydraulic and sedimentation loads, nutrient loading, shipping and recreational boating, and urban or storm water runoff. Probabilistic risk assessment methods will be used, where appropriate, to evaluate the results and uncertainty.

2.13 Public Participation Plan

Where relevant and appropriate, elements of the public participation process developed for the Tittabawassee River investigation will be referenced in Saginaw River / Bay RIWP and adapted for this work.

2.14 Other Plans

Where relevant and appropriate, elements of the Field Sampling Plan, Quality Assurance Project Plans, Health and Safety Plan, and Data Quality Objectives Plan developed for the Tittabawassee River investigation will be referenced in Saginaw River / Bay RIWP and adapted for this work.

3. SCHEDULE AND DELIVERABLES

The schedule and milestones for implementation of the work described in this SOW is presented in Table 3-1.

Table 3-1. Schedule of Saginaw River / Bay Work

Task	Timeframe
Submission of SOW to MDEQ	July 13, 2007; Revised October 15, 2007
Approval of SOW by MDEQ	---
Preparation of RIWP	
Preparation and Submission to MDEQ	Within 60 days after approval of the SOW
RIWP Phase 1 Activities	
Phase 1 Work	Winter 2007/08
Data Reporting	60 days after the end of each calendar quarter
Submission of Phase 1 Summary Report	At conclusion of work, prior to Phase 2 work
RIWP Phase 2 Activities	
Phase 2 Work	Spring/summer 2008
Data Reporting	60 days after the end of each calendar quarter
Submission of Phase 2 Summary Report	At conclusion of work, prior to Phase 3 work
RIWP Phase 3 Activities	
Phase 3 Work	Summer/fall 2008
Data Reporting	60 days after the end of each calendar quarter
Submission of Phase 3 Summary Report	At conclusion of work, prior to preparing final report
Overall Report of Findings	
Submission of Report of Findings	Spring 2009
Note: The schedule for Phase 1, 2, and 3 work is dependent upon MDEQ approval of the SOW, as well as approval of the subsequent RIWP and any supplemental work plans prepared during the course of the investigations and the Overall Report of Findings.	

4. REFERENCES

Barabás N, Goovaerts P, Adriaens P. 2001. Geostatistical Assessment and Validation of Uncertainty for Three-Dimensional Dioxin Data from Sediments in an Estuarine River. Environ Sci Technol. 35(16):3294-301. August 15.

Goovaerts, P. 1997. Geostatistics for Natural Resources Evaluation. Oxford University Press.

Michigan Department of Environmental Quality (MDEQ). 2006. *Table 5. Saginaw Bay Floodplain Total TEQ in ppt.* Final Report of Dioxin-Like Toxicity in the Saginaw Bay Watershed. Great Lakes National Program Office. Grant Project # GL965334010; and PBDE Distribution in the Saginaw Bay Watershed. Great Lakes National Program Office. Grant Project # GL96558601-0. Prepared by A.B. Taylor, D.R. MacKenzie-Taylor, A. Ostaszewski, J. M. McCabe. May 2, 2007. Revised August 31, 2006. Page 14 of 38.

*** END ***

TABLES

TABLE 1-1. Addressing the Requirements in The Dow Chemical Company's State of Michigan Hazardous Waste Operating License

Requirements in Dow's License	MDEQ Expectations for the Saginaw River and Bay RIFS *	Comments / Where Addressed in SOW
XI.B.3. - Submit for approval by the Chief of the Waste and Hazardous Materials Division	• May be able to use Technical Teams for advisory purposes or as part of the "working meeting" process	
XI.B.3.(a) - Identification of specific interim response activities (IRAs)	• Considerations could include expansion of current sediment trap pilot program	
XI.B.3.(b) - Phasing and prioritization of work and schedule	• Enforceable schedule is needed – critical component • Requirements of Part 201 R 299.5528(3) must be addressed [Remedial Investigation (RI) requirements] – see attachment • Also include sampling of public beaches and water plant intakes as identified in Framework document • Schedules for SOW work must be incorporated into the detailed Compliance Schedule under Condition XII.A. of the license	• The schedule of work is described in Section 4 of the SOW. • Requirements of Part 201 R.299.5528(3) are addressed in the SOW. • Sampling public beaches and water plant intakes will be conducted as part of Phase 1 work, as described in Section 3 of the SOW. • Proposed schedule in Section 4 of the SOW can be incorporated into the detailed Compliance Schedule.
XI.B.3.(b)(i) – Identification of additional exposure pathways	• Need to identify exposure pathways (including but not limited to high end fish and wild game consumers)	• Exposure pathways will be identified as part of Phase 2 work addressing human health and ecological risk assessment, as described in Section 2 of the SOW.

Requirements in Dow's License	MDEQ Expectations for the Saginaw River and Bay RIFS *	Comments / Where Addressed in SOW
XI.B.3.(b)(ii) – Process for selecting areas of investigation	• Use of sub-bottom profiling and bathymetry to assist in selection of sampling locations similar to proposal in MTR SAP • Current conditions report to identify data gaps • Public beaches and water intakes as identified in Framework document • Requirements of R 299.5528(3) need to be considered/addressed	• Bathymetry and geophysical surveys, including sub-bottom profiling, are proposed in Phase 1 work, as described in Sections 2 and 3 of the SOW. • A *Current Conditions Report* will be prepared in Phase 1 work, as described in Sections 1 and 2 of the SOW. • Sampling public beaches and water plant intakes will be conducted as part of Phase 1 work, as described in Section 3 of the SOW. • Requirements of R 299.5528(3) are addressed in the SOW.
XI.B.3.(b)(iii) – Proposed steps to determine if there are continuing sources of contamination	• Evaluation of Tittabawassee River as continuing source as well as Saginaw River and Bay reservoir sources	• The work will evaluate the likelihood of the Tittabawassee River as a continuing sources of contamination to the Saginaw River and Bay, as described in Section 2 of the SOW.
XI.B.3.(b)(iv) – Proposed steps to develop site-specific cleanup criteria	• Need to be considered	• Will be addressed as part of the Tittabawassee River RIWP process.
XI.B.3.(b)(v) – Ecological risk assessment	• Need to propose and include in schedule	• Ecological risk assessment activities will be included in Phase 2 work, as described in Section 2 of the SOW.
XI.B.3.(c) – Proposed plan for public participation	• Need to propose – may include ongoing quarterly meetings as part of public participation	• Elements will be adopted, where appropriate, from the Tittabawassee River RIWP process.
XI.B.3.(b) - Enforceable Schedule	• Critical component – needs to be proposed	• The schedule of work is described in Section 4 of the SOW.

Requirements in Dow's License	MDEQ Expectations for the Saginaw River and Bay RIFS *	Comments / Where Addressed in SOW
Alternate administrative option (i.e., similar to what is contemplated in XI.B.6. and 7.)	• May consider including in the schedule the development of an alternate administrative option to comprehensively address corrective action obligations	• Not addressed in the SOW. EPA issued Dow a Special Notice Letter on October 10, 2007,
XI.B.5. – Requirement to submit RI Work Plan	• Need to propose schedule	• The schedule of work is described in Section 4 of the SOW.

Note:

* The statements in Table 1-1 pertaining to requirements in Dow's License (column 1) and Michigan Department of Environmental Quality (MDEQ) expectations for the Saginaw River and Bay RIFS (column 2) were communicated to Dow by MDEQ on July 3, 2007.

FIGURES

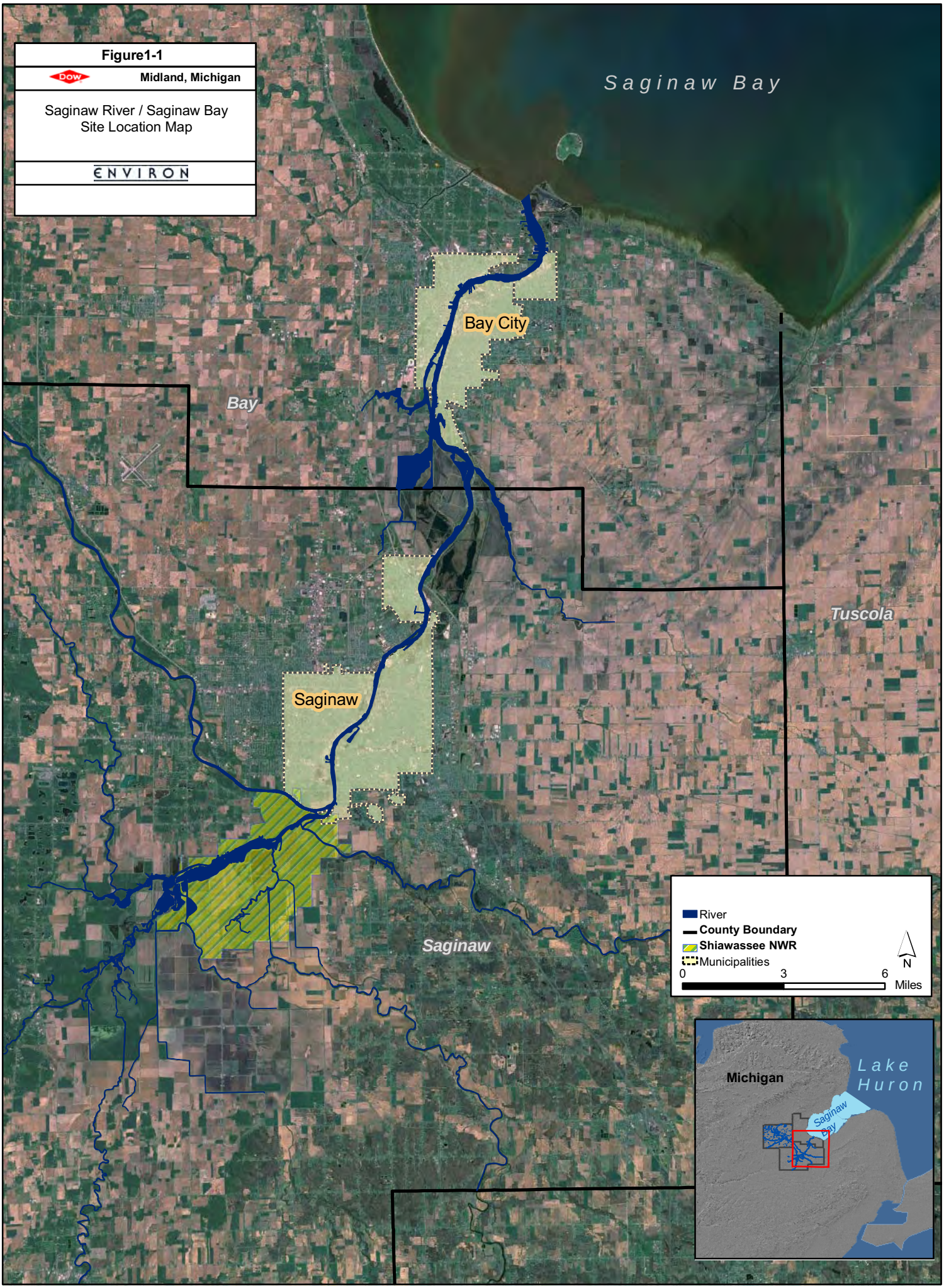
Figure1-1
Midland, Michigan
Saginaw River / Saginaw Bay
Site Location Map
ENVIRON
Saginaw Bay
Bay City
Bay
Tuscola
Saginaw
Saginaw
River
County Boundary
Shiawassee NWR
Municipalities
0
3
6
Miles
N
Michigan
Lake Huron
Saginaw Bay